Percival Lowell's fanciful planetology—and yet they underline why Viking went to Mars and Pioneer to Venus.

The aim of this book, that the atmosphere of a planet has a history, is marvelously achieved by Walker. His distinguished career at Yale and now his directorship of the atmospheric-science program at the Arecibo Observatory are clearly evident—for *Evolution of the Atmosphere* is the work of an excellent teacher and a very capable researcher. And like every good history, it's also a very enjoyable story to read.

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Lectures on Solid State Physics

G. Busch, H. Schade
538 pp. Pergamon, Oxford, 1977. $38.50 clothbound, $20.00 paperbound

Georg Busch of the Swiss Federal Institute of Technology is an internationally known physicist who has a long record of accomplishment to his credit not only in regard to the work of his laboratory but in regard to training scientific "generations" of young persons who themselves go on to contribute in physics. He has presented the distillate of his own interests and perspective in the book *Lectures on Solid State Physics* now translated and available in English.

This text represents a comprehensive and solid achievement in presenting a "classical-standard" version (circa 1950–65) of solid-state and especially semiconductor physics. The treatment covers several major areas of crystal-physics phenomena in a straightforward fashion, including lattice dynamics of perfect crystals, electronic processes in metals, semiconductors, junctions, transport problems and magnetism. In all these areas the treatment is thorough and careful—it presupposes a limited (elementary) knowledge of quantum mechanics, but eschews any "fancy" methods such as group theory or many-body physics or even perturbation theory of second or higher order.

Throughout, the emphasis is on obtaining understandable phenomenological results that can be quickly compared to experiment without elaborate calculation. The discussion of optical "band-edge" absorption in insulators may serve as an example. Busch gives a good qualitative discussion, illustrated with typical energy-band diagrams, of direct and indirect optical-absorption processes. He mentions exciton effects (but does not illustrate them). Nor does he derive, or even exhibit, any theoretical expression for the frequency dependence of optical-absorption coefficient that is of course essential in the interpretation of the data (presented here as a figure) in terms of the processes involved and the subsequent determination of electronic-band structure.

Busch's treatment of transport phenomena gives a very nice coverage of electron and hole contributions to the electrical and thermal conductivities. He nicely sorts out major effects and gives some useful definitions and illustrations of thermoelectric (Seebeck, Thomson, Peltier) and galvanomagnetic effects.

Perhaps more surprising in a book addressed to a modern (post-1976) solid-state-physics audience is the total absence or even mention of the term "quasi particle": the only mention of "exciton" is a brief definition (footnote) on page 248, while "magnon", "polaron" and "polariton" are not even mentioned. One must wonder why so ubiquitous a phenomenon in insulators as ferroelectricity finds no mention, and why one of the most interesting and exciting areas of contemporary solid-state physics—superconductivity—is deemed even unworthy of a footnote, while magnetism and ferromagnetic and magnetic ordering (without any mention of critical effects) occupy 15% of the text. *Chacon á son goût!*

To those whose taste runs to supplementing the theoretical treatment found in A. H. Wilson's *The Theory of Metals* (Cambridge, 1953) with some illustrative and pedagogically interesting examples, I would recommend perusal of this text. The care and explicitness of Busch's treatment may also help some neophytes become oriented in solid-state phenomena.

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Computer Techniques for Image Processing in Electron Microscopy

W. O. Saxton
289 pp., Academic, New York, 1978. $27.00

It is generally agreed that image processing is one of the important avenues for the further development of electron microscopy. The many possibilities for enhancing the resolution, contrast or information content of the images have been the subject of a large amount of effort in recent years. The fact that none of the methods developed to date has given any useful result in practice, with a few exceptions in very limited areas, has done nothing to discourage the search for even more powerful methods. This book by Owen Saxton is an excellent exposition of some of the more mathematically rigorous, computationally developed and conceptually intriguing aspects of the subject in which the author's own contributions are well known.

Image processing for electron microscopy has complications unknown for the equivalent subject in light optics. For low-resolution imaging, where the need for imaging processing is minimal, the incoherent-imaging theory of light optics can be applied with reasonable success. High resolution introduces the complications of coherent illumination of phase objects with objective-lens transfer functions that are complex and involve large phase changes as a result of the inescapable spherical aberration.

In principle it should be possible to use two or more defocussed images to deduce the actual phase change of the electron wave produced by a thin-phase object and hence to deduce the projection of the object structure with high resolution in spite of the lens aberrations. The Gerchberg–Saxton algorithm was put forward a few years ago as a major step toward accomplishing this task. The definitive statement on this idea and its further refinements and parallel developments forms a major part of Saxton's book. It is proposed that the complex object-transmission function can be derived from one image and an electron-diffraction pattern, both readily accessible. Reduced to its essentials, the question is "How far do the modulus of a function and that of its Fourier transform determine the phase of the function?"

After two chapters of mathematical preliminaries, Saxton treats this problem with rigor, but at a level that will daunt the nonmathematician and leave the vast majority of interested electron microscopists flipping the pages in search of some contact with their experience. The page-flippers will not be disappointed, because the processes are well illustrated by computer experiments on computer-generated data and the conclusions, although indefinite, are clearly stated. Saxton gives useful chapters on the hardware for digital image handling and on the software needed for all the basic operations of the wide range of image-processing techniques. There are relatively brief discussions of the reconstruction of three-dimensional objects from two-dimensional projections and the averaging of repeated structures, for which the practical applications to experimental electron micrographs have been extensive and important in recent years. Finally the book includes the computer programs developed in Cambridge by Saxton and colleagues, described in sufficient detail to make them useful.

The author has not attempted a com-